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METRICS
MECHANICAL ENGINEERING

A newsletter for alumni and friends of the Department of Mechanical Engineering

INSIDE

Mechanical Engineering Ranks 24th in the Nation

In April 2004, *U.S. News & World Report* "America's Best Graduate Schools 2005" ranked the Mechanical Engineering Graduate Program 24th overall, and 15th among public schools.

THE CLARK SCHOOL OF ENGINEERING as a whole ranked number 16 (10th among public universities), tied with Princeton University and University of California, Los Angeles.

Out of seven programs, six engineering disciplines in the Clark School were ranked among the top 25. Specifically, Aerospace Engineering is ranked 9th (5th among public universities), Electrical Engineering is ranked 14th (8th among publics), Computer Engineering is ranked 16th (9th among publics), Civil Engineering is ranked 22nd (15th among publics), and Materials Science is ranked 23rd (13th among publics).

This marks the first time the Department of Mechanical Engineering has ranked in the top 25.

Dr. Avram Bar-Cohen, Chair of the department, explains these improved ME department rakings. "Starting in the late-1990's, the Department began to focus on research and education in emerging microsystem technologies – including microelectronics, optical and fiber optic sensors, micro energetics, smart materials, and micro electromechanical systems. The faculty's success in these domains helped to propel the Department's research expenditures to top-tier levels among ME Departments nationwide. Annual faculty publication output increased to nearly 100 archival papers, 20 books and book chapters, and over 200 conference presentations each year. The department has outstanding representation among the Editors and Associate Editors of book series and archival journals, as well as chairs and keynote speakers in the major conferences of the engineering community."

"I believe that the Department's top-25 ranking reflects the cumulative effects of this "charge to excellence" and am confident that the quality of our faculty, researchers, and students will carry us to the very top of the academic ladder in the years ahead," states Bar-Cohen.

Dr. Ugo Piomelli, director of graduate studies in mechanical engineering applauds the improved rankings, "This new ranking provides further recognition of the quality of the ME graduate program and will aid in recruiting the very best students to Maryland."

Newsmakers
ME fosters international collaborations with Korea, Israel & India
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2002-2003 Annual Report
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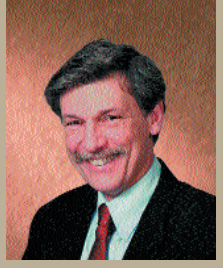
Innovation Lab Photo Album
A museum of student & faculty projects
page 14



Message From the Chair

IT IS A PROFOUND PLEASURE to welcome you to the Spring 2004 issue of METRICS, as the Mechanical Engineering Department basks in the glory of our first-ever top - 25, U.S. News and World Report ranking in graduate education.

This recognition of the quality and impact of the Mechanical Engineering program owes much to the faculty, students, and staff who in earlier decades worked tirelessly to lay the groundwork for this success. Special thanks are due to Professor Davinder Anand, chair of this Department from 1992 - 2002, for his insightful and unwavering leadership of ME during a pivotal period in its history. Gone are the black-topped laboratory tables, inclined manometers with colored water, and students huddling over clumsy, noisy tangles of equipment. Today much of the cutting-edge work conducted in the Department takes place on computers and in clean rooms, as well as on microchips and micro electromechanical systems. Our students and faculty now enjoy the latest instrumentation techniques in their quest for engineering breakthroughs.

This issue of METRICS will provide ample evidence that this is truly a wonderful time for our Department, I would hope that you will also recognize that this is an incredible time for the study and practice of mechanical engineering. Few disciplines can boast of a direct connection to each of the "three musketeers" of today's global research community – Nano, Info, and Bio. While numerous scientific breakthroughs are still required in each of these domains, if successful Nano-Bio-Info products are to emerge from the research laboratories, mechanical engineers will need to lend their skills to the development of precise modeling tools, effective design processes, and cost-effective fabrication processes in each of these domains. Surprisingly to some, it is the core disciplines of mechanical engineering – solid mechanics, fluid mechanics, thermodynamics, controls, energy conversion, design, and manufacturing – that underpin this product realization process.

The societal expectations for rapid introduction of emerging technologies and the fulfillment of the dreams of a cleaner, safer, more comfortable, more prosperous world, necessitate a more vigorous, predictable, and cost-effective product realization process. This necessity is profoundly changing how we educate mechanical engineers. Undergraduate students no longer just hit the books and rely on copious lecture notes. They work on product design directly with corporate mentors; participate in complex, hands-on design projects that focus on unmet societal needs; and compete in national events that test their skills at designing, building, and operating human powered submarines, solar houses, fuel efficient trucks, and autonomous vehicles.

Our MS and PhD programs in both Mechanical Engineering and Reliability Engineering are at the cutting edge of these emerging technologies and equip our graduates with interdisciplinary perspective, creativity, communication skills, and entrepreneurial zeal needed to succeed in academia, industry, and research laboratories where the spoils go to the smart, the talented, and the well trained practitioners of the art and science of engineering.

As you'll note in succeeding pages, in 2004 the Department boasts a powerful and accomplished faculty, increasingly recognized for providing leadership within the University and the professional community, for supporting a large and productive research enterprise, and for providing an ME education second to none, to the ever more accomplished graduate and undergraduate students attracted to this Department. We are also blessed with an outstanding administrative and technical staff whose skill and dedication have underpinned this success. And are grateful to our many alumni who've used their excellent education as a springboard for an impact-full and rewarding career. We look forward to continued progress in the years ahead as we accelerate our pursuit of excellence and aim for an ever higher position among the outstanding Mechanical Engineering Departments in this country and in the world.

- Dr. Avram Bar-Cohen

Retiring

Davinder Anand & David Holloway, Professors of Mechanical Engineering

Professor **Davinder K. Anand**, a 40-year veteran of the department, will retire in June 2004. After retirement, Professor Anand will continue to serve as the Director of the Center for Energetic Concepts Development. CECD is an alliance formed to foster advancements in energetics manufacturing, science and research, while educating the next generation of energetics experts. CECD seeks to establish a virtual research, development, manufacturing, and training center at Indian Head, Maryland. Anand served as the department chair from 1992 to 2002, helping foster the long-term success of the department.

After more than 30 years as a faculty member in the department, Professor **David C. Holloway** will retire at the end of the spring semester. After several months of travel he plans on returning to the department part time to continue advising the student automotive competition teams and to support the department's automotive research efforts. Holloway was an integral advisor to the winning solar-powerd car student project in 1990, which traveled to both Japan and Australia to compete. Holloway served as President of SAE International in 1997 and was a member of the National Academy of Science Committee for the Study of Motor Vehicle Rollover Rating System.

facultyNEWS

Dr. Jeong Kim the Latest ME Faculty Elected to National Academy of Engineering


Kim

Dr. **Jeong H. Kim** is among seventy-six new members and eleven foreign associates elected to the National Academy of Engineering (NAE) on February of 2004. Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. His election was based on his contributions to national defense and security through improved battlefield communication.

Dr. Kim is a professor of practice in electrical and computer engineering and mechanical engineering, and is also a faculty member of the reliability engineering program.

Dr. Kim is also the recipient of numerous awards and honors including Ernst & Young's Emerging Entrepreneur of the Year Award, KPMG Peat Marwick LLP High Tech Entrepreneur Award, and the Maryland High Technology Council Entrepreneur of the Year Award.

The Department of Mechanical Engineering at the University of Maryland has seven faculty who are members of the National Academy of engineering. In addition to Dr. Kim, the other faculty members include Arthur Bergles, James W. Dally, George E. Dieter, Robert E. Fischell, Katepalli Sreenivasan, and C.D. Mote, Jr., President of the University of Maryland - College Park.

Fullbright Scholar Yasser Shabana Joins ME Faculty in 2004

Dr. **Yasser Shabana** joins the department as a Fullbright Scholar for the remainder of 2004.

Professor Shabana is sharing his expertise and extensive knowledge of functionally graded and composite materials, microscopic analysis, micromechanics, finite element method and thermo-elasto-plasticity for the next nine months. He is working with Dr. Hugh Bruck in the Functionally Graded Materials Development Laboratory during this time.

In addition to receiving the Fullbright lecturing and research grant, Professor Shabana has most recently served as an Assistant Professor in the Mechanical Design Department at Helwan University.

Professor Shabana earned his Ph.D. in Industrial Science and Engineering at the Shizuoka University of Japan, and his M.S. and B.S. in Mechanical Design at Helwan University.

New Fellows


Azarm

Professor **Shapour Azarm** has been elected to the status of Fellow within the American Society of Mechanical Engineers (ASME). The ASME Fellow Grade recognizes significant engineering achievements and contributions to the engineering profession.

ASME recognizes Dr. Azarm as a leading researcher and practitioner of design optimization and for his significant contributions to multicriteria, multidisciplinary decision making for design of complex mechanical systems.


Piomelli

Professor **Ugo Piomelli** was elected to the grade of Associate Fellow in the American Institute of Aeronautics and Astronautics (AIAA). Piomelli's research focuses on numerical simulation of turbulent and transitional flows.

AIAA Associate Fellows are individuals of distinction who have made notable and valuable contributions to the arts, science, or technology of aeronautics or astronautics.

Faculty Promotions


Bruck

Professor **Hugh Bruck** will be promoted to Associate Professor of Mechanical Engineering with tenure in July 2004. Bruck a specialist in the materials science field, and is the director of the Functionally Graded Materials Development Laboratory.


Ramahi

Professor **Omar Ramahi** will be promoted to Associate Professor of Mechanical Engineering with tenure in July 2004. Ramahi also holds an Affiliate position as an Assistant Professor of Electrical and Computer Engineering, and is the director of the Electromagnetic Compatibility and Propagation Laboratory (EMCPL).


Zachariah

Michael R. Zachariah is appointed to Professor of Mechanical Engineering and Chemistry with tenure as of Fall 2004. Zachariah is the coordinator of the UMCP/NIST Co-Laboratory on NanoManufacturing and Metrology.

In Brief


Balaras

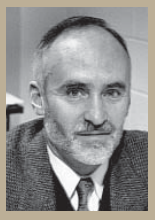
Assistant Professor **Elias Balaras** received the Faculty Early Career Development (CAREER) Award for his work on Large-Eddy Simulation of Turbulent Flows with Dynamically Moving Boundaries. The NSF Faculty Early Career Development (CAREER) Program fosters the career development of outstanding junior faculty, combining the support of research and education of the highest quality and in the broadest sense.


Bar-Cohen

Chair and Professor of Mechanical Engineering **Avram Bar-Cohen** was recently selected to be an Editor of the prestigious and long running book series, *Advances in Heat Transfer*, which reviews articles or monographs on special topics in heat transfer of current interest. Bar-Cohen was also recently elected to serve on the Executive body of the ASME ME Department Heads Committee.


Modarres

Professor of Reliability Engineering **Mohammad Modarres** received the Food and Drug Administration's Commissioner's Special Citation as a member of the Risk Analysis Professional Development Team. Prof. Modarres was selected for this award for providing invaluable assistance to FDA providing tools for improving food safety and decision-making.


Duncan

Mechanical Engineering Professors **James Wallace** and **James Duncan** were elected to the Executive Committee of the American Physical Society's Division of Fluid Dynamics (APS-DFD).

The Division of Fluid Dynamics of the American Physical Society exists for the advancement and diffusion of knowledge of the physics of fluids with special emphasis on the dynamical theories of the liquid, plastic and gaseous states of matter under all conditions of temperature and pressure.


Wallace

Professor Wallace serves as Chair of the committee for one year. He served the DFD as Vice Chair in November 2001 and Chair-Elect in 2003. He will continue to be on the Executive Committee in November 2004 as Past-Chair.

Professor Duncan has been elected Secretary-Treasurer for a three-year term.

Wallace has also been selected for the 2004 University System of Maryland Regents' Faculty Award for Excellence in Teaching and was appointed to be a member of the Burgers Board to help promote awareness of fluid dynamics on campus and abroad.


Cukier

Assitant Professor of Reliability Engineering **Michel Cukier** received the Faculty Early Career Development (CAREER) Award in August 2003 for his work with Probabilistic Evaluation of Computer Security based on Experimental Data. The goal of this research project is to evaluate the security of a computer network based on experimental data (i.e, vulnerability and attacker data collections). This research will benefit the security community by providing a measure that is probabilistically quantified and is based on previous data collections of vulnerabilities (system, network, and application vulnerabilities) and attacks to assess the security of a computer network.

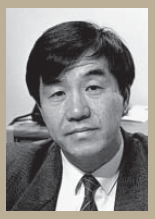

Ramahi

Professor **Omar Ramahi** was installed on the Board of Directors of the Applied Computational Eletromagnetics Society (ACES) during their annual conference.

ACES is an international, inter-disciplinary, professional society, with a wide range of activities and services.


Yang

Assistant Professor **Bao Yang** received the 2004 ORAU Ralph E. Powe Junior Faculty Enhancement Award. The award provides seed money for research by junior faculty at Oak Ridge Associated Universities (ORAU) member institutions. The awards are intended to enrich the research and professional growth of young faculty and result in new funding opportunities. This award represents public recognition by academic peers of the quality and promise of Dr. Yang's research, specifically with his research on nanostructured materials for thermoelectric application and superlattice structures.


Zhang

Associate Professor **Guangming Zhang** has been selected to receive the 2003 Poole and Kent Company Senior Faculty Teaching Award. This award consists of a handsome wall plaque and a prize of $1,000. Dr. Zhang was selected for this award as a testament to the impact that he has made on education and the curriculum in the college.

A.K. Gupta Chosen for Prestigious Appointments, Awards


A. Gupta

Professor **Ashwani Gupta** was invited to be a member of the Nanotechnology Technical Advisory Group (TAG) of the President's Council of Advisors on Science and Technology (PCAST) in June 2003. In response to a request by President Bush, PCAST is undertaking a review of the National Nanotechnology Initiative (NNI).

The purpose of TAG is to provide input and feedback to the PCAST as it conducts its NNI review. In order to perform its review, PCAST has formed three Task Forces in the following areas: Materials/Electronics/Photonics; Energy/Environment; and Biology/Medicine/Societal Issues.

Although the TAG will not be required to meet as a whole, individual members may be called upon to participate in discussions with members of one or more of the task forces, or may be contacted occasionally by phone or email.

The TAG will be composed of experts in nanotechnology representing a range of disciplines. The fields in which Dr. Gupta is particularly knowledgeable are critical components of the NNI-sponsored research and development program.

Dr. Gupta was also awarded the ASME James Harry Potter Gold Medal in November 2003 during the ASME International Mechanical Engineering Congress held in Washington, D.C.. The James Harry Potter Gold Medal was established in 1980, and is given in recognition of eminent achievement or distinguished service in the appreciation of the science of thermodynamics in Mechanical Engineering. The basis of the award includes contributions involving the teaching, appreciation or utilization of thermodynamic principles in research, development and design in Mechanical Engineering. The award consists of a $2000 honararium, vermeil medal and certifcate.

Gupta and his student Sean Archer received the American Society of Mechanical Engineers Best Paper Award at the 23rd Annual Computers and Information in Engineering conference held in Chicago, Illinois on September 2-6, 2003.

The award was given for their paper entitled "Swirl and Combustion Effects on Flow Dynamics in Lean Direct Injection Gas Turbine Combustion" which was also presented at the conference.

Dr. Ashwani K. Gupta has been a faculty member in the Mechanical Engineering Department at the University of Maryland, College Park since 1983. He spent six years at MIT as a member of the research staff in the Energy Laboratory and Department of Chemical Engineering, and three years at Sheffield University as an independent research worker and research fellow in the Department of Chemical Engineering and Fuel Technology. He has over 30 years of experience in combustion engineering since his graduation from Southampton University in 1970.

Gupta is also the recipient of the 2003 Kirwan Faculty Research and Scholarship Prize granted in October. The prize recognizes a faculty member for a highly significant work of research, scholarship or piece of artistic creativity.

Balachandran Part of Business Plan Competition Finalist Team


Balachandran

Pervasive Technology Engineering was a finalist in the 2004 University of Maryland Business Plan Competition, earning 2nd place in the Graduate Student Category on Friday, May 7.

Mechanical Engineering Professor **Balakumar Balachandran** is the consultant for the group, which consists of Mechanical Engineering Research Assistant Moustafa Al-Bassyiouni and Mohamed Eltowissy, faculty member from Virginia Tech.

Pervasive Technology develops fiber optic pressure sensors for automobile and airplane engines to help increase fuel efficiency, reduce harmful emissions, and to predict dangerous engine malfunctions and breakdowns. Balachandran has been working fiber optic pressure sensors, or 'optical microphones,' since 1995. Pervasive's sensors won the university's 2002 Invention of the Year award.

The competition is open to students and recent alumni who generate the best plans for new companies. The finalists, whittled down from an original field of 56, are in such areas as emergency data recovery, hacker protection, optical fiber sensors, Internet publishing, blogging and video game enhancements.

Duncan Named Distinguished Scholar-Teacher


Duncan

Mechanical Engineering Professor **James Duncan** has been selected as a 2004-2005 Distinguished Scholar-Teacher.

The Distinguished Scholar-Teacher Program honors faculty who have demonstrated outstanding scholarly achievement along with equally outstanding accomplishments as teachers.

As a Distinguished Scholar, Professor Duncan will receive funds to support instructional and scholarly activities. He will also make a public presentation in the fall 2004 semester on a topic of scholarly interest.

CALCE Develops Simulation Software for Lead-Free Modeling

CALCE has completed development of rapid modeling software to assess the durability of lead-free package-to-board interconnects under life cycle loading conditions. The lead-free durability model is part of the calcePWA software and is based on research conducted at the CALCE EPSC.

With the movement to lead-free accelerating as the 2006 deadline rapidly approaches, Original Equipment Manufacturers (OEMs) face a number of challenges. One challenge is the package-to-board interconnect reliability due to stresses during temperature cycling. While there is a general consensus that lead-free interconnects will be at least as durable as current tin-lead interconnects, tests have indicated that this may not always be the case.

Over the past four years, CALCE has conducted investigations to characterize the behavior of the leading lead-free solder candidates. In this effort, the constitutive and durability properties of selected lead-free solders have been determined. While there is still some question as to which lead-free solder compositions will be used, the tin-silver-copper solder alloy appears to be the leading candidate for reflow.

To address the interconnect durability issue, CALCE has developed various modeling techniques to assess the life expectancy of lead-free solder interconnects. Simulation techniques range from detailed finite element modeling of packages subjected, to cyclic stress to rapid life assessments contained within the calcePWA software. CALCE has validated these modeling techniques against both internal and external data.

The CALCE Electronic Products and Systems Center (EPSC) is an interdisciplinary research center sponsored by over 50 commercial corporate and government organizations from all sectors of the electronics systems industry. Over the last 15 years, CALCE EPSC has invested over $45M in developing methodologies, models, and design tools that address the design and manufacturing of electronic systems. CALCE EPSC is recognized as a founder and driving force behind the development and implementation of physics-of-failure approaches to reliability and life cycle prediction, as well as a world leader in accelerated testing, and electronic parts selection and management

For more information about CALCE, please visit their website at:
http://www.calce.umd.edu/

CECD Center Signs New Dept. of Defense Contract


Anand

The University of Maryland at College Park and the Naval Weapons Surface Center at Indian Head have signed a new $10 million five-year cooperative activity contract in support of The Center for Energetics Concepts Development (CECD). This contract involves research and education in the broad field of energetics and includes fundamental research in materials, design, safety, mems and lean manufacturing. This work is a continuation of activities performed previously by CECD under a five year contract. The Director of the Center is Dr. D. K. Anand, Professor of Mechanical Engineering. and former Chair of the department of mechanical engineering. For more information about CECD visit:
http://www.enme.umd.edu/CECD/

U.S. Department of Energy Selects CEEE as New Regional Heating Center

The Center for Environmental Energy Engineering (CEEE) is partnering with the Maryland Energy Administration to establish one of six Regional Application Centers for Combined Heat and Power (CHP). CEEE is directed by Professor Reinhard Radermacher.

Governor of Maryland Robert L. Ehrlich, Jr. announced in September that the University of Maryland will be home to the new Mid-Atlantic Regional Combined Heat and Power Application Center. The Center will promote distributed heating and power technologies in six states and the District of Columbia: Maryland, Delaware, Pennsylvania, New Jersey, West Virginia and Virginia.

The University will receive funding for the Center through the Maryland Energy Administration (MEA). MEA and the University of Maryland worked as partners in seeking $300,000 in federal funding from the United States Department of Energy's Office of Energy Efficiency and Renewable Energy, (EERE). The Grant, awarded on a competitive basis, is distributed through DOE's State Energy Programs Office in Philadelphia, PA. The award of this to the CEEE reflects the history of successful CHP research that has been conducted within the Center. The Application Center will be run by CEEE staff and physically located within the Mechanical Engineering building on campus.

For more information on MEA's industrial energy efficiency programs or the Combined Heat and Power Application Center visit the website *http://www.chpcenterma.org.*

Above: Mechanical Engineering graduate student Xiahong Liao troubleshoots the microturbine at the Cooling, Heating, and Power (CHP) Integration Test Center at the University of Maryland. The goal of the center is to deliver a small packaged CHP system that is grid independent.

- Photo Courtesy of John T. Consoli

Clark School Awarded Department of Defense MURI Award

A MULTIDISCIPLINARY UNIVERSITY RESEARCH INITIATIVE AWARD (MURI) was granted to the A.J. Clark School of Engineering from the Department of Defense in March 2004. The award is at the level of approximately one million dollars per year for three years with two additional optional years, and focuses on the development of revolutionary concepts and navigation advancements in micro hovering air vehicles. It is a significant addition to the portfolio of research programs in the Clark School.

Professors Elisabeth Smela and S.K. Gupta are participating faculty members from Mechanical Engineering who join principal investigator Dr. Inderjit Chopra an Alfred Gessow Professor in the Aerospace Department.

Smela

S.K. Gupta

Let Us Hear You ROAR!

WE ARE ALWAYS EAGER TO HEAR HOW YOU ARE DOING! The department is eager to hear about alumni stories, accomplishments and updates.

Please share your news with Jim Barrett, Marketing and Communications Coordinator by e-mail at *jcb@umd.edu*, or by phone at (301) 405-2097.

ME Develops International Partnerships with Korea, Israel and India

Over the past year the Clark School of Mechanical Engineering has developed international research, information and faculty exchanges with institutions and research centers in Korea, Israel and India.

ISRAEL ELECTRONICS CORPORATION, TEL AVIV

During a visit to the Tel Aviv University in November of 2003, Governor of Maryland Robert L. Ehrlich, Jr. announced the formation of a new research collaboration project between Maryland and the Israel Electronics Corporation. The Joint Center for Reliable Electronic Systems (CRES) will conduct and coordinate joint reliability research between the University of Maryland Clark School of Engineering and the Tel Aviv University Fleischman Faculty of Engineering.

The Center's mission is to study the reliability of "commercial off the shelf parts" (COTS) currently used in sophisticated electronics and to develop guidelines for increased lifetime without sacrificing quality. CRES will also serve as an academic resource for seminars and training to Israeli and outside companies who design, build and maintain robust systems where the expected life far exceeds that of the COTS from which the systems are built.


Bernstein

"Israel's economy is heavily dependent on durable products, with more than half her electronics output sold in the Military, Aerospace, Medical, Telecom and Infrastructural markets" said Dr. Joseph Bernstein, Associate Professor at the University of Maryland Reliability Program who on sabbatical at Tel-Aviv University. "Israel is the ideal place to form a center that serves high-reliability manufacturers because her economy uniquely depends on providing long lifetime, low maintenance cost products built with COTS that are normally designed for consumer electronics."

Attending the announcement were representatives from IAI, Rafael, Elbit, Tower semiconductor, as well as Maryland based companies including Northrup Grumman, BAE Systems and M/A-COM.

HANYANG UNIVERSITY, KOREA

In the early spring of 2004, a collaboration was fostered with the College of Engineering and ME Department at Hanyang University, one of the top engineering schools in Korea. Professor Jae-Eung Oh, the Provost at Hanyang University in Korea, initiated this cooperation between the two universities.

While visiting the University of Maryland the week of February 17, 2004, Professor Oh worked closely with the Chair of the Department of Mechanical Engineering, Dr. Avram Bar-Cohen. He was able to meet with the President of the University of Maryland, C.D. Mote, Jr. to discuss details about the collaboration and to extend a formal invitation to the President to visit Hanyang University. Professor Oh also met with Drs. Balachandran and Piomelli, Dean Farvardin, and Saul Sosnowski, the Director of International Programs.

In the early stages, the collaboration will be centered on mechanical engineering and will allow Hanyang University to learn from Maryland's emergence as one of the top research universities in the United States. The collaboration will encourage visiting scholar or researcher exchange, joint research programs, graduate student and academic materials exchange.

Professor Oh also serves as the Director of the Mechanical Engineering Division of the "Brain Korea 21" program and would like to see Maryland become part of the Korean effort to raise the quality of their science and technology human resources in this arena. Professor Oh was on sabbatical at the University of Maryland last year with Professor Balachandran before being recalled to Hanyang to serve as Provost.

In April 2003 the College and Department signed a cooperation agreement with Hanyang. At Professor Oh's invitation, Dr. Avram Bar-Cohen visited their two campuses to get to know their faculty and facilities, and to lay the groundwork for further cooperation. While in Hanyang, Dr. Bar-Cohen also met with Professor Chong Yang Kim, the President of Hanyang University, who voiced strong support for this Agreement and future collaboration with Maryland in education and research.

INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE

The Department of Mechanical Engineering at the University of Maryland hosted Professor S.K. Joshi, Chairman, Board of Governors and Professor Prem Vrat, Director, Indian Institute of Technology (IIT) Roorkee, India on May 16, 2004. Established in 1847, IIT Roorkee is one of the oldest Engineering Colleges in the British Empire. The Institute has 18 academic departments, 1 academic center, and 7 other centers and units with roughly 3,500 students.


Bruck

The visit was organized by Professor Atma Sahu of the Mathematics Department at Coppin State and Professor Hugh A. Bruck of the Mechanical Engineering Department. The main focus of the meeting was to explore possibilities of US-India collaboration in research. Discussions involved possible faculty sabbaticals at IIT Roorkee, as well as considering the opportunity of meeting with potential faculty candidates.

Department of Mechanical Engineering Annual Report 2002-2003

A special pull-out section to the Spring 2004 issue of *Metrics*

The Year in Review

Avram Bar-Cohen
Professor and Chair

Dear Friends, Alumni, Faculty, and Students,

The 2002-2003 academic year was a memorable one for the Department of Mechanical Engineering—filled with accolades, accomplishments, and new opportunities. I could not have wished for a more rewarding year as the Department Chair and I hope the brief recapitulation and statistics that follow will serve to reinforce our collective pride in the significant steps taken in 2002-2003 towards the upper echelons of academia.

DURING THIS PAST ACADEMIC YEAR, OUR FACULTY published more than 125 archival articles, book chapters, and books, while presenting nearly 330 Conference presentations and seminars, among them 18 Plenary and Keynote lectures. While our student population this year rose to 645 undergraduates and 358 graduate students, the Department awarded 91 BS degrees, 61 MS degrees and 22 PhD degrees. Despite a less than stellar economy, research expenditures reached $15.8 million, bringing our overall department expenditures in 2002-2003 to more than $21.4 million.

Continuing the remarkable success of our junior faculty, Professor Elisabeth Smela received a prestigious NSF CAREER award for her work on MEMs actuators for microrobotics. Professor A.K. Gupta's career contributions in combustion were recognized with the USM Kirwan Research award and the ASME James Harry Potter Gold Medal. At the June 2003 graduation the Clark School Service Award and the Poole and Kent Senior Faculty Teaching Award were presented to Professors Schmidt and Duncan, respectively.

This year was marked by the success and media attention granted the ME-led and advised Clark School Solar Decathlon student team, which received the 4th place award for the design, construction, and operation of the solar house on the National Mall. The Department's Pi Tau Sigma student section flawlessly organized, financed, and hosted the national Pi Tau Sigma Convention in February 2003. Many of our faculty were honored and recognized by their respective professional societies, bringing the Department's total to 43 Fellows, 20 Journal Associate Editors, and 11 Journal and Book Series Editors.

continued on following page

Department at a Glance — FY 2003

44	Faculty
43	Professional Society Fellows
6	National Academy of Engineering Members
11	Journal & Book Series Editors
20	Journal Associate Editors
7	Published Books
14	Published Book Chapters
97	Published Journal Articles
311	Conference and Seminar Presentations
18	Plenary / Keynote Speakers
645	Undergraduate Students—Fall 2002
1260/1390	SAT 25/75 Percentiles of Entering Freshmen
3.93/4.0	Average GPA of Entering Freshmen
35	Percentage of Women/Minority Entering Freshmen
25	Percentage of Undergraduates in Honors Programs
358	Graduate Students—Fall 2003
2044	Average GRE of Entering Graduate Students
3.59/4.0	Average GPA of Entering Graduate Students
91	B.S. Degrees Awarded
61	M.S. Degrees Awarded
22	Ph.D. Degrees Awarded
$15.8M	External Research Support
$21.4M	Total Expenditures
234	Research Grants
144	Research Sponsors

2002-2003 M.S. Graduates & Advisors

Fall 2002

Mohammad Abo El So-oud
Advisor: A. Baz

Mohammad Al-Ajmi
Advisor: A. Baz

Vijaya Chebolu
Advisor: O. Ramahi

Matthew Cowie
Advisor: R. Radermacher

Jeremy Cunningham
Advisor: M. Pecht

Radwan Kalo
Advisor: M. Ohadi

Sivasankar Pandeti
Advisor: F. Buckley

Zeke Topolosky
Advisor: P. McCluskey

Ji Wu
Advisor: M. Pecht

Spring 2003

Wael Akl
Advisor: A. Baz

Moustafa Al Bassyiouni
Advisor: B. Balachandran

Elissa Bumiller
Advisor: M. Pecht

Derya Calhan
Advisor: P. Sanborn

Kevin Cochran
Advisor: D. DeVoe

Douglas Crane
Advisor: G. Jackson

Ali Farhangmehr
Advisor: S. Azarm

Sean Gahagan
Advisor: J. Hermann

Subroto Gunawan
Advisor: S. Azarm

Yue Huang
Advisor: D. Bigio

Huiqing Jin
Advisor: H. Bruck

Rohit Kumar
Advisor: J. Hermann

Jaya Police Patil
Advisor: F. Buckley

Mihai Rada
Advisor: M. Ohadi

Joli Rightmyer
Advisor: D. Holloway

Eric Stellrecht
Advisor: B. Han

Vinay Subramanian
Advisor: O. Ramahi

Surumi Thorpe
Advisor: M. Ohadi

Ivan Tong
Advisor: D. Holloway

Valentin Tudor
Advisor: M. Ohadi

Zafer Tuncali
Advisor: D. Anand

Niranjan Vijayaragavan
Advisor: M. Pecht

Summer 2003

Arvind Chandrasekaran
Advisor: P. McCluskey

Sungyeol Cho
Advisor: B. Han

Jonathan Coursey
Advisor: D. DeVoe

Anthony Ferguson
Advisor: D. DeVoe

Jeffrey Kramer
Advisor: G. Jackson

Thomas McGrath
Advisor: G. Jackson

Deborah Pollack
Advisor: B. Han

Alok Priyadarshi
Advisor: S.K. Gupta

Anoop Rawat
Advisor: M. Pecht

Roxanna Sai
Advisor: G. Jackson

Nathan Sniadecki
Advisor: D. DeVoe

Niranjan Vijayaragavan
Advisor: M. Pecht

Yunqi Zheng
Advisor: P. McCluskey

Professional Master of Engineering Program

Program Advisor: Keith Herold

Deborah Lynn Kowalczyk Althoff
Steven Frank Busch
Joseph John Coblish
Murat Gozu
Winston Kain Harris
Mark Koffman Harris
Jerry Steven Salan
Young-sil Shin
Michael Joseph Vilcheck
Sandeep Vohra
Brian Adam Weiss

The Year in Review

continued from page AR 1

Upon the completion of a year-long process, the department celebrated the integration of the Reliability Engineering graduate program and its primary faculty into Mechanical Engineering. This integration brought Professor of Practice Jeong Kim to this department to join with Professor of Practice Robert Fischell in providing Mechanical Engineering with a unique bridge to the high-technology industry in the region and in the world.

For the first time in 2002-2003 the department hosted a "Faculty Night Out," with music and dinner for faculty and their spouses at the Clarence Smith Performing Arts Center. The department also sponsored an ME Alumni Reception at the ASME IMECE conference in DC. Among other firsts, ME co-sponsored a Workshop on BioSensors with the FDA in College Park and established a broad collaboration with NIST in Nano Metrology and Manufacturing.

Clearly then, 2002-2003 has been a wonderful year for UMD's Mechanical Engineering Department. Your support, commitment, talent, and skill – singly and collectively - have made this all possible and are greatly appreciated.

2002-2003 Graduate and Undergraduate Programs

Dr. Ugo Piomelli
Director of Graduate Studies and Associate Chair

Dr. Sami Ainane
Director of the Undergraduate Program

Enrollment

In the 2002-2003 academic year the Department of Mechanical Engineering had 358 graduate students enrolled. Of these 144 were Master of Science students and 244 were Doctoral students. 20% of these students were minority or female.

Degrees

The Department granted 61 M.S. degrees and 22 Doctorates in 2002-2003. Dissertation titles and the names of Doctoral student's advisors are listed later in the report.

Recruitment

As of November 1, 2003, 752 students applied to the graduate program for entrance in 2003-2004. This represented a 23% increase over the number applying in the previous year. This increase is no doubt due to the growing reputation of the Department and our efforts in publicizing our departmental accomplishments. Of these applicants, 100 were accepted and 60 enrolled, most with financial assistance in the form of a graduate teaching assistantship, graduate research assistantship, or graduate fellowship.

Research and Fellowships

During the 2002-2003 academic year, the department supported 39 students through teaching assistantships and 171 students through research assistantships. We can boast of providing graduate assistants with the third highest base stipend of any university in the country, the highest of any public university. In addition, 25 of our students have been awarded fellowships for the 2002-2003 academic year.

Student Credentials

The students who enrolled in our program in 2003-2004 had an average GRE total of 2044 and an average GPA of 3.59.

Enrollment

Enrollment in the undergraduate program during the 2002-2003 academic year has increased by over 48% in the past three years. Currently, 650 students have declared Mechanical Engineering as their major. Roughly 27% of these were minority or female. 156 are in the University Honors Program. The freshmen class of 2003 had an average SAT score of 1333 and an average high school GPA of 3.93. Last year, we awarded 91 Bachelor's degrees. Our program features design throughout the undergraduate curriculum and unique teaching methods, including teaming studio experience and the use of Undergraduate Teaching Fellows.

Career Paths

Several areas of concentration are suggested to the student in his or her senior year. These areas of focus, such as Design and Manufacturing; Controls, Sensors & Electronic Packaging; MEMS Technology; Energy & Environmental Engineering; Automotive Engineering; Robotics; and Engineering Management enable students to study in depth their areas of interest and to better prepare themselves for careers of their choice.

AR 3

Honors Program

The departmental Honors Program, now in its fourth year, consists of three levels of involvement available to students. The University has a general honors program primarily for freshmen and sophomores, the School of Engineering has an honors program primarily for juniors and seniors, and the Department of Mechanical Engineering has an honors program for students at all levels. It is possible for students to participate in any combination, including all, of the three honors programs The program currently has about 100 participants and has been highly successful in attracting talented students to the Department.

B.S./M.S. Program

Our department offers a combined B.S./M.S. Program, which is available to the top students in the department. This program

continued on following page

2002- 2003 Undergraduate Awards & Honors

American Society of Mechanical Engineers Senior Award
Presented to the senior member who has contributed most to the student chapter
Jason Leblanc

Pi Tau Sigma Outstanding Service Award
Presented to a student for outstanding service and contributions to the chapter
Raleigh Stewart

Pi Tau Sigma Memorial Award
Presented to the senior in mechanical engineering who has made the most outstanding contributions to the University
Robyn Hladish

Pi Tau Sigma Outstanding Sophomore Award
Presented to the most outstanding sophomore in mechanical engineering on the basis of scholastic average
Thomas Baummer

Department of Mechanical Engineering Academic Achievement Award
Presented to the junior in mechanical engineering who has attained the highest overall academic average
Aaron Joseph Johnson

Department of Mechanical Engineering Chair's Award
Presented for excellence in academics, outstanding service to the Department, or leadership in the Department
Anita Maria Currano

continued from page AR 3

provides these students with the opportunity to earn both a B.S.M.E. and an M.S.M.E. following five years of study.

Student Organizations and Projects

The number of student chapters of national professional societies continues to grow. This growth is an indication of the increasing variety of interests among our students and our faculty. Currently, there are student chapters of the American Society of Mechanical Engineers, Society of Automotive Engineers, the American Society of Heating, Refrigeration and Air Conditioning Engineers, Society of Experimental Mechanics, and the Society of Manufacturing Engineers.

Over the past decade, the department has established an enviable record in intercollegiate student competitions. Regional, national, and international competitions in Mini-Baja vehicles, solar cars, autonomous robots, methanol cars, liquefied natural gas powered vehicles, hybrid-electric cars, future cars, walking robots, super-mileage vehicles, human powered vehicles, human powered submarines, the Solar Decathlon, and others have resulted in numerous prizes and honors for our students and faculty. This success has provided many of our graduates with opportunities to receive employment offers in a wide variety of industries.

2003 Graduate Awards & Honors

Graduate School Fellows
Vytenis Benetis
Antonio Cardone
Lorenzo Cremaschi
Amr Gado
Mohammad Reza Keimasi
Kyle Kratzsch
Martin Linck
Gregg Lithgow
Cheng Shao
Zhen Shi
Pameet Singh
Bretton Swope
Travis Temple
Zuezheng Wang
Shenglan Xuan
Jianming Yang
ZiaboYao
Xiabo Yao
Zhihua Yue
Krista Zaniewski
Lei Zhang
Yuxun Zhou
Bin Zhu
Likun Zhu

Litton Industry Fellow
Ali Farhang-Mehr

SRC Fellow
Deborah Pollack

Trigen Fellows
Sandeep Nayak
Eric Xuan

2002-2003 Ph.D. Graduates & Dissertation Titles

Fall 2002

Mandar Chincholkar
Advisor: J. Herrmann
Design for Production: Using Manufacturing Cycle Time Information to Improve Product Development

Xinan Liu
Advisor: J. Duncan
An Experimental Investigation of Effects of Surfactant on Spilling Breaking Waves

Aristotle Marantan
Advisor: R. Radermacher
Optimization of Integrated Microtubing and Absorption Chiller Systems in CHP for Building Applications

Gregory Schultz
Advisor: D. Holloway
A Parallel Hybrid Transmission

Stephen Smee
Advisor: D. Anand
A Low Background Double Focusing Neutron Monochromator

Mathew Wagenhofer
Advisor: M. Natishan
Development of a Simulation and Optimization Tool for Heat Exchanger Design

Miao Yu
Advisor: B. Balachandran
Fiber-optic Sensor Systems for Acoustic Measurements

Spring 2003

Saeed Asiri
Advisor: A. Baz
Isolation of Helicopter Gearbox Vibrations Using Periodic Support Struts

Casey O'Connor
Advisor: F.P. McCluskey
Influence of Rapid Altitude Cycling on the Reliability of Plastic Encapsulated Microcircuits

Leon Lantz
Advisor: M. Pecht
The Measurement of Diffusion in Epoxy Molding Compounds Used to Encapsulate Microelectronics Devices

Rajath Mudalamane
Advisor: D. Bigio
Process Variation and the Transient Behavior of Extruders

Mohammad Tawfik Abo El So-ooud
Advisor: A. Baz
Vibration Control of Plates Using Periodically Distributed Shunted Piezoelectric Patches

Summer 2003

Douglas Crane
Advisor: G. Jackson
Optimizing Thermoelectric Waste Heat Recovery from an Automotive Coiling System

Ali Farhangmehr
Advisor: S. Azarm
Entropy Approach to Meta-Modeling, Multi-Objective Genetic Algorithm, and Quality Assessment of solution sets for Design Optimization

Hans-Joachim Huff
Advisor: R. Radermacher
Integrated Compressor-Expander Devices for Carbon Dioxide Vapor Compression Cycles

Haobo Jiang
Advisor: R. Radermacher
Development of a Simulation and Optimization Tool for Heat Exchanger Design

Jun-Pyo Lee
Advisor: R. Radermacher
Experimental and theoretical Investigation of Oil Retention in a Carbon Dioxide Air-Conditioning System

Xuejun Li
Advisor: S.K. Gupta
Geometric Algorithms for Automated Design of Multi-Stage Mold for Manufacturing Multi-Material Objects

Hai Shi
Advisor: L. Schmidt
Strategies for Generating Feasible Conceptual Design Comparing HTN Planning with Grammar Based Design

Valentin Tudor
Advisor: M. Ohadi
Control of Frost Growth in Refrigeration Systems Using the Ehd Technique

Ricky Valentin
Advisor: D. Barker
A Rapid Failure Assessment Approach for Insertion Mounted Solder Interconnects Under Thermomechanical Cycling

Ji Wu
Advisor: M. Pecht
Electrical Characterization and Reliability Assessment of Lead-Free Solder Coated Electrical Contacts

FY '03 Contracts, Grants, and Awards

PI	Agency	Title
Anand	Advanced Thermal&Environm	EHD-Enhcnced Air-to Liquid Heat Exchanger
Anand	ATEC	Chip Integrated EHD Cryogenic Cooling System Phase II
Anand	DOD- Navy.NSWC	Center for Energetic Concepts Development
Anand	DOD-Navy.ONR	University Laboratory Consortia Research on Undersea...
Anand/ Devoe	DOD-Navy.NSWC	International Shock Wave Conference
Anand/Allen	NIST	Research on Web-Enabled Collaboration
Azarm	NSF	Robust Product Design Selection Under Uncertainty...
Azarm	DOD-Navy.ONR	ConCurrent Design Optimization
Azarm	NSF	Entropy Based Multiobjective Genetic Algorithm
Azarm/McCluskey/Pecht	DOD-Navy.ONR	Decision Support of Design of High Resonator Systems
Balachandran	Air Force	Nonlinear Oscillations of Microscale Piezoelectric
Balachandran	NSF	High-Speed Milling Dynamics
Balachandran	NSF	Novel Fiber Optic Acoustic Sensor System
Balachandran	TEDCO	Fiber-Tip Based Fabry-Perot Sensots for Acoustic
Balachandran/Baz	DOD-Navy.ONR	Virtual Platform for Design and Control of Structures
Balares	Georgia Tech	Computational Modeling of Mechanical Heart Valves
Bar-Cohen	Sony Corporation	Cost Effective and Advanced Passive Cooling Technologies
Baz	Big Bang Products	Hearing Protection for Ear Warmers
Baz	Business Performance Grp	Integrated Simulation-Based Design Environment
Baz	Catholic University	Active & Passive Comtrol of Vibrations
Baz	DOD-Army.ARO	Acitve & Reactive Shells
Baz	DOD-Naval Air Warfare Center	Aging of Fiber Optic Cables
Baz	DOD-Navy.ONR	Virtual Design of Quiet Underwater
Baz and Davis	Qortek Inc.	Multifunctional Integrated Piezo-Fiber Modulation System
Bernard	VorCat, Inc.	Gridfree Compressible Turbulent Flow Modeling
Bernstein	DOD NSA	Laser Restructuring Process Development
Bernstein	Mission Research Corp	Laser Programmable Analog Array Software Development
Bernstein	NIST	Advanced Gate Dielectric Reliability and Metrology
Bernstein	NIST	Ultra-Thin Oxide Metrology and Reliability
Bernstein	Texas A&M	Methods to Account for Accelerated Semiconductor
Bigio	Dupont Dow	Determination of FluoroElastomers Role in Reducing...
Bigio	Intelligent Automation	Polypropylene-based AVI Guard Products
Bigio	MULTI COMP	Polymer Mixing Program (PMP#2)
Bruck	Penn State	Characterization of Mechanical Performance of Propellants
Bruck	DOD-Navy.ONR	Fabrication & Design of a Functionally Graded Materials
Bruck,	U of South Carolina	Dev. of Functionally Graded Metal Ceramic Armor Composites
Buckley	Carnegie Mellon	LIBs for Real-Time Ambient Particle Analysis
Buckley	DOD-Navy.ONR	Particle Diagnostics for Navy Vehicles and Operations
Buckley	NSF	RET Supplement for NSF Award
Buckley	Systems Planning & Analysis	Exhaust Gas Trace Species Detection System for Turbine Engines
Buckley	Systems Planning & Analysis	Ship Structural Health Monitoring Using Fiber Optics
Buckley/Balachandran	Systems Planning & Analysis	Towed Array Shape Management
Buckley	NSF	Investigation of Laser-Induced Breakdown Spectroscopy
Cardenas	NSF	Development of a Bi-Axial Micro-Tensile of MEMS
Cukier	BBNT Solutions	BBN Proposal PO2-BBN-317/DARPA
Cukier	BBNT Solutions	ITUA Validation land Assessment Extension Project
Dasgupta/Devoe	NSF	A MEMS-based Stiffness/Energy Sensor for Structural
DeVoe	Calibrant Biosystems	Field Effect Flow Control for Advanced Bioanalysis
DeVoe	DOD-ARPA	Parallel Fabrication of 3D Microsystems
DeVoe	DOD-MD. Procurement of	III-V MEMS for Optical Microsystems
Devoe	DOD-Navy.ONR	A Deep Reactive Ion Etcher
Devoe	NIST	Integrated Silicon/Plastic Microfluidic Gas Sensors
DeVoe	NIST	MEMS Test Structures for Materials Characterization
DeVoe	NSF	PECASE: Mechanically Robust Macromems
DeVoe, Balachandran	DOD-ARPA	High-Q Piezoelectric Nanmechanical Filter Arrays
Duncan	DOD-Navy.ONR	An Experimental 2D+T Investigation of Breaking Bow Waves
Duncan	DOD-Navy.ONR	The Effects of Salinity and Wind on the Surface Profiles
Duncan	NSF	The Dynamics of Short Wavelegth
Duncan	DOD-Navy.ONR	Equipment for the Study of Breaking Wind Waves
Duncan, James	NSF	The Effects of Surfacants on Breaking Wind Waves
Duncan/Kiger	NSF	Air Entrainment by Translating Plumes
Fourney/Cardenas	Georgia Tech	Multifunctional Energetic Functional Materials
Gupta A.K.	DOD-Navy.ONR	Control Flame Structure in Spray
Gupta A.K.	DOD-Navy.ONR	Phase Doppler Interferometer
Gupta A.K.	Japan Science & Tech. Corp	Thermogravimettry Anaysis Coal & Wastes

Gupta A.K.	NASA - Glenn (Lewis)	Database on Fuel Air Mixing & Bombustion
Gupta A.K.	NASA - Glenn (Lewis)	Studies on the Behavior of Highly Preheated Air Flame...
Gupta A.K.	NSF	Experimental & Theoretical Studies of the Structure of...
Gupta A.K.	Teledyne Energy Systems	Burner Development for TP Systems
Gupta SK	DOD-Navy.ONR	Automated Mold Design and Fabrication
Gupta, AK	DOD-Navy.ONR	Two-Phase Reacting Flow Subjected to Temporal and…
Gupta, Bruck, Magrab, Smela .	NSF	Curricuclum Enhancement to Introduce Product Development
Gupta, SK	Automated Precision, Inc.	Improving Accuracy of Three-Dimensional Shape Replications
Gupta, SK	Carneige Mellon	Automated Extraction for Structured MEMS Design
Gupta, SK	NSF	PECASE: Automated Design of Multi-Piece Molds (Career)
Gupta, SK	NSF	REU Career Supplement
Han	Intel Technology	Practical Approach of Microscopy
Han	Semiconductor Research	Development of Displacement Measurement Techniques
Han	Semiconductor Research	SRC National Semiconductor Scholarship
Holloway	DOE - CHICAGO	Gate Fellowship Application
Holloway	General Dynamics	Hybrid Electric Drivetrain
Holloway	MD Grain Prod. Utl Board	Development of and Ethanol Fueled Hybrid Vehicles
Jackson	California Energy Comm.	Integral Catalytic Combustion Fuels
Jackson	DOD-Navy.ONR	Development of Design Models for Hydrogen Catalytic Heating
Jackson	NSF	Development & Validation of Surface Chemistry Models for...
Jackson and Eichorn	Colorado School of Mines	ONR MURI Subcontract on Direct Electrochemical Oxidation
Jackson/Kiger	NSF	Impact of H2 and CO on Lean Premixed Hydrocarbon Flames
Joshi	DOD-Navy.NSWC	Microfabrication Alliance for Innovative Cooling Microelectronics
Kiger	NSF	Acquisition of a Phase Doppler Anemometer for Engineering Ed.
Kiger, Modarres	NRC	High-Resolution Experimental Measurement of Turbulent...
Kiger/Kim	DOD-MD. Procurement of	Heat Transfer Measurements on Isothermal Surfaces
Kim	ATEC	Heat Flux Sensor with Minimized Impact on Boundary...
Kim	NSF	Graduate Student Participation in the 5th Internnational Conf...
Kim J	NASA - Other	Pool Heat Transfer Mechanisms
Kim J	NIST	Fabrication of Data Acquisition & Micro-Test Section Heater Array
Kim J	NSF	Transition Pool Boiling Heat Transfer
Kim J	University of Denver	Time & Space resolved Heat Transfer
Kim/Jackson	NIST	Development of a High Temperature Absorption Coefficient
McCluskey	Georgia Tech	Web-based Graduate Course on Mechanical Design
McCluskey	NASA - John H Glenn	Package Technology Evaluation
McCluskey	Silicon Power Corporation, Inc.	Reliability Assessment of ThinPak Modules
McCluskey	Virginia Polytechnic Institute	Characterization of Large Area Solder Die Attach Fatigue
McCluskey	Virginia Polytechnic Institute	Graduate Fellowship in Large Area Solder Attach Fatigue
Modarres	NRC	Probabilistic Assessment and Applications
Mosleh	DOT-FAA	Hazard Classification Framework and Risk Analysis
Mosleh	NASA- Ames	Model-Based Hazard Analysis Mehtod and Simulation Tool
Mosleh	NRC	Probabilistic Assessment and Applications
Mosleh	University of Virginia	PRA Tool Feasibility Study
Ohadi/Kiger	TEDCO	Development of a Micro-condenser for Source-Integrated...
Pecht	DOD- Army.Aberdeen	Physics of Failure Source Mechanism Determination
Pecht	DOD-MD. Procurement of	Manufacturability and Durability Analysis of Single…
Pecht	JHU Applied Physics Lab	Effect of Long Dormancy on Electronics Reliabilty
Piomelli	DOD-Navy.ONR	Comparison of Wall-Layering Modeling Techniques
Piomelli	NASA - Langley	Transition Mechanisms on Multi-element Airfoils
Piomelli	NIST	Evaluation of MEMs Ultrosonic Transducer Arrays
Piomelli	NASA - Langley	Interaction of Boundry Layers
Piomelli, Balares	Air Force	Infow Condition for Large Eddy Simulation
Piomelli, Balares	DOD-Navy.ONR	Wall-layer Models for Large Eddy Simulation
Radermacher	ARTI	CO2 Expander-Compressor Analysis
Radermacher	ATEC	Advanced Heat Exchangers and EHD Oil Separators
Radermacher	Battelle	Operation of CHP Systems, Measurement and Data Evaluation
Radermacher	DNR/Energy Administration	Maryland Industries of the Future Program
Radermacher	DOD-Army.ARO	Modeling & Testing of Commercial Protype Carbon Dioxide...
Radermacher	DOE/ORM	Mid-Atlantic Application Center
Sanborn	Potomac Photonics, Inc	ReliabilityTesting and Cost Analysis of Electronic...
Sandborn	Frontier Technology Inc	EPOI Life Cycle Cost development for AFRL and ASC
Sandborn	Lockheed Martin	Part Obsolescence Forecasting
Sandborn	Northrup-Grumman	Electronic Parts Obsolescence Initiative
Sandborn	Nu Therna Systems, Inc.	Advaced Embedded Passives
Sandborn and Ramahi	Applied Data Systems	Design of Embeded Computer Systems for Automotve Environments
Sandborn/McCluskey/Pecht	AF.AFMC.Wrght.Patt	Life Cycle Cost Reduction Through a Cradle-to-Grave Approach...

Schmidt	NIST	Research on Uncertainty Measurement for CMM Software
Schmidt	NSF	A Career in Generative Design Methodology
Schmidt	NSF	A Pilot Investigating Functional Roles on Engineering...
Schmidt	NSF	E-volving the Open Workshop on Decision Based Design
Schmidt	NSF	Research Internships in Science and Engineering
Schmidt	NSF	REU Support to Career: Generative Design Methodology
Schmidt, Bigio	NSF	BESTEAMS Model of Team Development
Smela	Advanced Thermal & Enviromental Concepts	MIPS Source - Integrated Micro Cooling Device
Smela	DOD- Army	Modeling Charge Transport in Conjugated Polymers
Smela	DOD-ARPA	Optical Fiber Sensors for Detecting Action Potentials...
Smela	Infinite Biomedical Technologies Corp	Intraurethal Continent Prothesis (ICNCOPRO)
Smela	NSF	CAREER - Development of Advanced MEMS Actuator
Smela	NSF	Cell Clincs on a Chip
Smidts	DOD-MD. Procurement of	Concurrent Modeling for High Assurance Software
Smidts	NASA-Goddard	Evaluation of Software Engineering Methodologies
Smidts	NASA-Goddard	Integrating Software in PRA
Wallace	DOE - Dept. of Energy	Fundimental Thermal Fluid Physics
Wallace	Idaho Natl Eng. & Env. Lab	Advanced Computational Thermal Fluid Physics (CTFP)
Wallace	NSF	Concentration Flux Measurements
Wilkinson	Lockheed Martin	Ultrasonic Wireless Data Collection
Zhang G	NYU	Machinable Ceramics: Optimizing Performance
Zhang G	U. MED. & DENT/NIH	Machiining Ceramic Materials
Zhang G	U. MED. & DENT/NIH	Minority Graduate Assistant Suppliment

FY '03 Research Sponsors

AAVID
AF.AFMC.Wrght.Patt
AFOSR - Bolling
Agilent Technologies
AIAA
American Society for Engineering Ed.
AMSAA
Applied Data Systems
Arcelik
ARL
ARR, Inc.
ARTI
ASEE
ASHRAE
ATEC
Automated Precision, Inc.
BAE Systems
Battelle
BBNT Solutions
Big Bang Products
Black & Decker
Boeing
Boland Trane
Brazeway
Business Performance Group
Calibrant Biosystems
California Energy Commission
Capstone
Carneige Mellon
Catholic University
Ciena
Colorado School of Mines
Copeland
Corvis
Daikin
Delphi Delco
Denso
DNR/Energy Administration
DOD - Air Force
DOD - Army
DOD - Navy
DOD NSA
DOD - DARPA
DOD - Naval Air Warfare Center
DOD - NSWC
DOE - Dept. of Energy
DOT - Dept. of Trans.
Dupont Dow
E. Kerr
EADS
EMC
Emerson Electric
EPA
EPRI Solutions
FAA
FIT
Frontier Technologies
General Dynamics
General Electric
Geomet Technologies
Georgia Tech
Goodrich
Grandfos
Halla Climate
Halliburton
Hamilton Sundstrand
Heatcraft
Honeywell
Idaho Natl Eng. & Env. Lab
IEEE
Infinite Biomedical Technologies, LLC
Intel
Intelligent Automation
Italian Embassy
ITRI
Japan Science & Tech. Corp
JHU Applied Physics Lab
KETI
LG Electronics
Lockheed Martin
Lucent Technologies
Maryland Energy Administration
Maryland Grain Producers Utilization Board
Matsushita
Medtronics
Michelin
MIPS
Mission Research Corp
MULTI COMP
NASA
National Semiconductor
NIST
Nokia
Northrup-Grumman
NRC
NSF
Nu Therna Systems, Inc.
NYU
Oak Ridge National Laboratory
ONR
Penn State
Pepco
Pepsi
Perkin Elmer
Philips
Potomac Photonics, Inc
QinetiQ
Qortek Inc.
QSS
Raytheon
RIST
Rockwell Collins
RTKL Associates, Inc.
Samsung
Sandia
Sanyo
Schlumberger
Seagate
Semiconductor Research
Siemens
Silicon Power Corporation, Inc.
Sony Corporation
SRC
Sun Microsystems
Systems Planning & Analysis
Tecumseh
TEDCO
Teledyne Energy Systems
Telinks, LLC
Texas A&M
Thermo King
Trane
Trigen
TRW
U of South Carolina
U. MED. & DENT/NIH
UK Ministry of Defense
United Nations
Univ. of South Carolina
University of Denver
University of Virginia
UT Battelle
UVA
Virginia Polytechnic Institute
VorCat, Inc.
Wolverine

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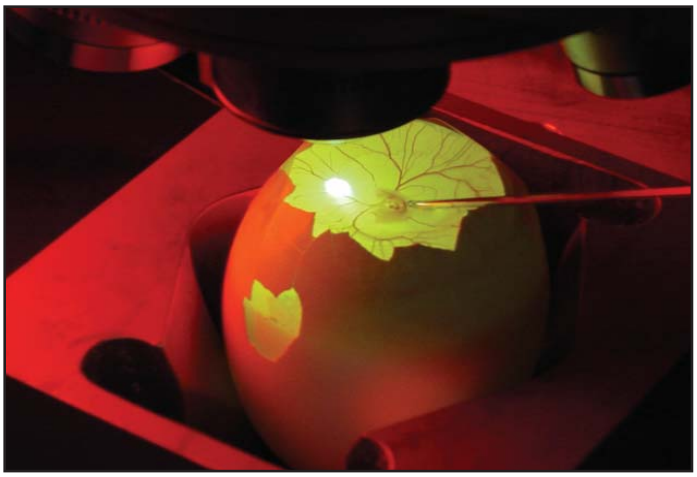
Kiger on Flow Dynamics Sabbatical in The Netherlands

Kiger

Associate Professor of Mechanical Engineering Ken Kiger spent the fall of 2003 at the J.M. Burgers Center at the Technical University of Delft performing research for the development of improved Particle Image Velocimetry (PIV) techniques for *in vivo* flow measurement.

The goal of the research was to try and adapt quantitative imaging techniques commonly used in engineering fluid mechanics research for use in measurement within living systems. For this specific example, his research group wanted to be able to measure the flow profiles and the hydrodynamic shear stresses applied to the walls of an embryonic avian heart. The biomedical colleagues working with Kiger's group have previously conducted experiments using chicken embryos as a model, which indicate that altering the flow pattern through the primitive tube-shaped heart of very young embryos typically results in significant defects within an adult four-chambered heart. They have speculated that this is a result of the change in shear stress patterns caused by the flow alteration, but until now, they did not have the means to quantify specifically how the shear stress in the heart was altered.

The majority of the research was based in The Netherlands, with engineering collaboration between Kiger and Professor J. Westerweel, Dr. R. Lindken, and Mr. P. Vennemann at TUDelft. Biomedical specialists involved in the project included Professor R. E. Poelmann and Dr. B. P. Hierck at Leiden University and Dr. N.T.C. Ursem, Dr. S. Stekelenburg-de Vos, and Dr. T.L.M. ten Hagen from the Erasmus Medical Center in Rotterdam.



Above: A chicken egg with an exposed embryo, along with a pulsed-Doppler ultrasound probe and the microscope used to obtain the images.

NSF Research & Development Study Ranks ME in Top 20

The University of Maryland Department of Mechanical Engineering has consistently ranked in the top fifteen in total research and development expenditures at American colleges and universities, according to recent National Science Foundation (NSF) studies. Research conducted in 1999 through 2001 and published in the National Science Foundation documents Academic Research and Development Expenditures: Fiscal Years 1999 – 2001, show that the University of Maryland ME department has ranked 12th in 1999 and 2000, and 15th in 2001.

The table below shows relevant data from the NSF studies:

Year	Total R&D Expenditures by university	Federally-funded R&D expenditures by university	Non-Federal R&D expenditures by university	Total R&D expenditures in mechanical engineering	Federal R&D expenditures in mechanical engineering
1999	32nd	30th	26th	12th	17th
2000	36th	38th	32nd	12th	15th
2001	36th	41st	31st	15th	14th

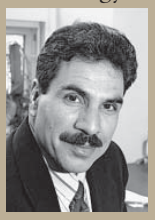
From: *Academic Research and Development Expenditures: Fiscal Years 1999 - 2001.* National Science Foundation.
http://www.nsf.gov/sbe/srs/nsf03316/start.htm

When Keeping Cool is a Hot Topic in Electronics

By Ellen McCarthy, Washington Post Staff Writer
Monday, January 26, 2004; Page E05

Electronics are growing smaller, faster and more powerful. But that trend may soon hit a wall, John S. McKillop said, if manufacturers do not figure out a way to pack more energy into a small device without making it overheat.

ADVANCED THERMAL AND ENVIRONMENTAL CONCEPTS INC., the College Park start-up McKillop joined as chief executive earlier this month, is working to sort out that problem with technology that grew out of a university research lab. The company was founded by Michael Ohadi, a professor of mechanical engineering at the University of Maryland.


Ohadi

The start-up is one of several firms chasing down a method of cooling products without interfering with their functions. Advanced Thermal's solution is still in development and may not win the race against other venture-capital-funded companies, McKillop admits. He expects that Advanced Thermal will know within six months whether it is a contender.

Meanwhile, the nine-person company has built a business on consulting and customization services. If a manufacturer of electronic motors, for example, develops a version of a product but finds the motor releases so much heat that it stops working, ATEC uses existing technologies to design a cooling system tailored to the product. McKillop said that because the expertise is relatively rare, Advanced Thermal has been successful in attracting large, international customers.

"The issue is, this is a real problem. Manufacturers are out beating the bushes and are looking for us," he said.

He also believes the team's customization work might lead to a number of new products that could be patented and sold to a variety of companies. Advanced Thermal has landed about $5 million in government grants to continue its research, but the contract work has allowed the company to generate a stream of revenue that should sustain the company even if its big gamble never pays off, McKillop said.

ME Staff D.B. Galpoththawela establishes Trust in Sri Lanka

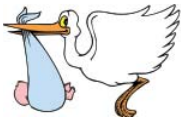

Galpoththawela

Mechanical Engineering staff member D.B. Galpoththawela has established a development fund in cooperation with the Department of Public Trustee of Colombo, Sri Lanka. "My mission is to give something back to the community, especially in the memory of my parents and grandparents," states D.B.

The 'D.B. Galpoththawela Fund' will grant annual cash awards to the Best All-Around Students of Trinity and Dharmaraja colleges in Kandy, and the Galagedara Central College and Medawela Central College of Harispaththu.

D.B. will also make annual contributions to Uggalgoda, Medawela, Dodangastenna and Galkotuwa Buddhist temples during the annual Vesak celebrations in memory of his parents and grandparents.

New ME Babies!



Congratulations to the following Mechanical Engineering faculty and staff who have welcomed new additions to their families in 2003:

Sophia Blattau, born August 23, to Research Assistant Nathan Blattau and his wife, Christine.

Jahnavi Das, born December 8, to Dr. Daganta Das and his wife, Rama.

Jacob Hillman, born November 1, to Craig Hillman and his wife Joyce Raynor.

Galinos Hristu, born August 26, to Assistant Professor Dimitris Hristu and his wife, Maria.

Luca Piomelli, born November 20, to Professor Ugo Piomelli and his wife, Jennifer.

studentNEWS

ME Ph.D. Student Awarded Prestigious ARCS Fellowship


Ovchinnikov

Mechanical Engineering Ph.D. student Victor Ovchinnikov was named the Achievement Rewards for College Scientists (ARCS) Endowment Fellow for the 2004-2005 academic year. The field of candidates for the Fellowship consisted of students from five area universities, in a wide range of disciplines.

The ARCS Foundation is a national volunteer women's organization dedicated to providing financial support to academically outstanding students majoring in the fields of natural science, medicine and engineering. The generous endowment is being granted by the Metropolitan Washington Chapter of ARCS.

Mr. Ovchinnikov obtained his Bachelor of Science Degree from Georgetown University, summa cum laude, with a double major in Mathematics and Biochemistry. He was admitted into the M.S. Program in Mechanical Engineering at the University of Maryland in the Fall of 2001. He transferred to the Ph.D. program in the Fall of 2003. Mr. Ovchinnikov's Ph.D. Advisor is Professor Ugo Piomelli, who has worked closely with him for over two years.

Victor's research involves the study of transition in boundary layers subjected to high levels of free-stream disturbance. He is currently focusing on the interaction between wakes and boundary layers, the type that is encountered near the leading edge of airplane wings when high-lift devices (such as leading-edge slats) are deployed.

His work has appeared in two AIAA conference papers, one presented at the 2003 Aerospace Sciences Meeting, one to be presented at the 2004 Aerospace Sciences Meeting. He has also published an Abstract in the Bulletin of American Physical Society, and presented a paper at the 2003 Meeting of the American Physical Society / Division of Fluid Mechanics, which is the premier forum for research in turbulence and transition.

Spring 2004 Senior Design Awards

The first place winners of the Fall 2003 Senior Design Award was given to a team consisting of Jamie Aleman, Nima Ashkeboussi, Timothy Frame, John Francis, Jeffrey Hertz and Charles Howe. Their winning design was of a continuous variable pulley transmission.

The second place award went to a design for a robotic mopping device. Honorable mentions go to designs in a vehicle assisted entry-exit seat, a mechanical bay grass planter, and a methane/manure conversion device.

The Senior Design Award is part of the ENME 472 course, Senior Capstone Design, taught by Professor Henry W. Haslach, Jr. Awards are given on based on presentation, innovation and good design.

ME Undergrad Launches Auto Performance Parts Business

Anthony Messina, Mechanical Engineering undergrad student, "has always wanted to start my own business." Encouraged by his experience doing business with a friend, he launched Custom Performance Engineering, creating custom auto parts for Subaru, Ford and Mazda vehicles.

Using subleased space in Beltsville, Maryland, Messina is currently modifying, manufacturing and marketing custom air induction systems and guage bezels engineered with the help of CNC mills.

Messina draws his expertise from engineering coursework such as computer-aided design and manufacturing automation (ENME 498M) taken at the College Park campus. For more information about his company, visit the Custom Performance Engineering website at: *www.cp-e.com*.

In Memoriam: Swaminathan Gowrisankaran

The department extends its condolences to the family of 23-year old graduate student Swaminathan "Swami" Gowrisankaran, who drowned in July after stopping to swim near a waterfall while hiking in West Virginia.

Gowrisankaran, originally of Chennai, India was studying for his doctorate in mechanical engineering under the advising of Dr. Hugh Bruck. Active in graduate student activities, Gowrisankaran served as the president for the Society for Experimental Mechanics as well as the treasurer for the Student Council of India.

Third Year Mechanical Engineering Student Wins $1000 ASME Scholarship

Congratulations to Ms. Selin Mariadhas who has been awarded a scholarship of $1000 by the Washington, DC Section of the American Society of Mechanical Engineers (ASME) for her ongoing research project in prosthetics.

The long-term goal of Selin's research project is to make prosthetics that can be controlled by thought. Selin plans to accomplish this by using an optical fiber sensor, so small that it would be less likely to be rejected by the body. This sensor would connect a person's nervous system to the prosthetic device, allowing handicapped people to use mechanical limbs that function nearly as well as the original limbs.

Robotics Racing Team Shift Gears

Reprinted with permission from Engineering @ Maryland Magazine

Michael Armani, a junior mechanical engineering student, has always been up for a challenge. His research experience at the Clark School has armed him with the basic skills, including data collection and analysis and algorithm development, to tackle one of his latest projects—the DARPA (Defense Advanced Research Projects Agency) Grand Challenge Contest.

The DARPA Grand Challenge (DGC) is an autonomous robotic race, which requires off-road vehicles to travel 300 miles of California terrain, mainly the Mojave Desert, in under 10 hours without human intervention. The challenge is part of a congressionally-mandated program to facilitate robotic development and to make one third of the U.S. military ground forces autonomous, or computer driven, by 2015.

After learning of the challenge from a friend, Armani single-handedly drafted a 10-page proposal to DARPA in early fall for the event, which is open to virtually any non-government employee from students to renowned robotics researchers. From 80 papers received by DARPA, 45 papers and respective authors, including Armani, were selected as potential participants to vie for the challenge's $1 million prize. While Armani was not selected to advance to the final competition this year, he enjoyed the experience and has his eyes on the prize for the 2005 DGC.

"I competed in the challenge with major players in the field of robotics," says Armani. "I entered the challenge because my skills fit, I liked the project and I liked finding sponsorship." A number of small companies provided support to Armani's efforts, including software, computer assistance, and a global positioning system (GPS). The Clark School of Engineering also provided funding for the project.

His team includes fellow mechanical engineering majors Chris Eliot and Mark Chambers, computer science major Jason Lettman and Bernie LaFrance, machinist of the J. M. Patterson Machine Shop. Sami Ainane, director of undergraduate programs, has served as advisor for the team, which plans to race in the International Robotic Racing Federation competition in September 2004 for a similar $1 million prize.

The Team Armani vehicle will cost less than $25,000 and its success will rely on a complex algorithm that allows the all-terrain vehicle (ATV) to detect obstacles on camera. The distance-to-object information will be gleaned through one camera aboard the ATV and processed by the GPS. Armani hopes to seek a patent for his new camera technology in the months to come.

"Our team was the second youngest in the DARPA competition and I view this as a great way to build credibility for future research," says Armani, who can frequently be spotted tooling around campus on his custom-built, motorized mountain bike.

Above: Junior mechanical engineering major Michael Armani, pictured on his customized mountain bike, developed an autonomous robotic racing vehicle that he hopes to enter in an upcoming national competition. - Photo Courtesy of John T. Consoli

A Woman Can Learn Anything a Man Can

by Carolyn Turk, Mechanical Engineering Alumni

When I was a kid, everything in my bedroom was pink. I have two sisters and we had a complete miniature kitchen, a herd of My Little Ponies and several Barbie and Ken Dolls. We didn't have any toy trucks, G.I.Joes or basketballs. We did have a Wiffle-ball set, but you would have been hard-pressed to find it in our playroom. Tomboys we weren't.

So some people may find it ironic that I grew up to be a mechanical engineer. In fact, I am the only female engineer at my company. In order to get my college degree, I had to take a lot of math and science classes. I also had to work with a team of students as part of a national competition to convert a gas-guzzling SUV into a hybrid electric vehicle - that's where I learned how to fix cars. I'm proud to say that I got A's in most of my classes, including multivariable calculus and differential equations. I've always been pretty good at math and design, but I didn't understand where that could take me. I was expected to go to college, but no one ever told me I'd make a good engineer someday.

When I was in high school, I didn't know the first thing about engineering. I couldn't have distinguished a transmission from an alternator. The car I drove needed some work but I was afraid to take it to the mechanic. Because honestly, the mechanic could have shown me an electric can opener and said, "This part of your car is broken - pay me to fix it," and I wouldn't have known any better.

At the end of my junior year of high school, I heard about a summer program designed to interest girls in engineering. The six-week program was free, and students were given college credit and a dorm room at the University of Maryland. I applied to the program, not because I wanted to be an engineer, but because I was craving independence and wanted to get out of my parents' house for six weeks.

I was accepted to the program and I earned six engineering credits. The next year I entered the university as an engineering major. Five years later I had a degree and three decent job offers.

I can't help shuddering when I hear about studies that show that women are at a disadvantage when it comes to math. They imply that I am somehow abnormal. I'm not, but I do know that if I hadn't stumbled into that summer program, I wouldn't be an engineer.

When I was growing up I was told, as many students are, to do what I am best at. But I didn't know what that was. Most people think that when you are good at something, it comes easily to you. But this is what I discovered: just because a subject is difficult to learn, it does not mean you are not good at it. You just have to grit your teeth and work harder to get good at it. Once you do, there's a strong chance you will enjoy it more than anything else.

In eighth grade I took algebra. On one test I got only 36 percent of the answers correct. I failed the next one, too. I started to think; maybe I'm just no good at this. I was lucky enough to have a teacher who didn't take my bad grades as a judgment of my abilities, but simply as an indication that I should study more. He pulled me aside and told me he knew I could do better. He let me retake the tests, and I pulled my grade up to an A.

I studied a lot in college, too. I had moments of panic while sitting underneath the buzzing florescent lights in the engineering library on Saturday afternoons, when I worried that the estrogen in my body was preventing me from understanding thermodynamics. But the guys in my classes had to work just as hard, and I knew that I couldn't afford to lose confidence in myself. I didn't want to choose between my femininity and a good career. So I reminded myself that those studies, the ones that say that math comes more naturally to men, are based on a faulty premise: that you can judge a person's abilities separate from the cultural cues that she has received since she was an infant. No man is an island. No woman is, either.

Why are we so quick to limit ourselves? I'm not denying that most little girls love dolls and most little boys love videogames, and it may be true that some people favor the right side of their brain, and others the left. But how relevant is that to me, or to anyone, as an individual? Instead of translating our differences into hard and fast conclusions about the human brain, why can't we focus instead on how incredibly flexible we are? Instead of using what we know as a reason why women can't learn physics, maybe we should consider the possibility that our brains are more powerful than we imagine.

Here's a secret: math and science don't come easily to most people. No one was ever born knowing calculus. A woman can learn anything a man can, but first she needs to know that she can do it, and that takes a leap of faith. It also helps to have selective hearing.

Carolyn Turk is a 2000 graduate of the Mechanical Engineering program. As an undergrad, Carolyn participated in the 1999 FutureTruck competition for two semesters and participated in a seven-month co-op with BP Solar, working with the manufacturing process engineering on their solar cell manufacturing line. Today, Carolyn conducts product development at a biotech company that makes biological screening instrumentation.

Innovation Lab Museum Photo Album

The Department of Mechanical Engineering "Innovation Lab", a museum of award-winning student/faculty projects, was launched on April 24 for Maryland Day.

The Innovation Lab features five exhibits of various engineering competition entries spanning twenty years of faculty and student involvement. The museum is located in the Manufacturing Building (building 148) of the College Park campus.

Some of the exhibits, like the Human-Powered Submarine, are still in use as current classroom projects. Others, like the walking robot and jousting robot, were created in the 80's to compete in international competitions.

Other exhibits include a solar-powered car, human-powered vehicle, and a model of a solar house entered in the 2002 Solar Decathalon held on the National Mall.

The Innovation Lab is available for tours with advance notice for groups of up to twenty people. Please contact Sami Ainane, Director of Undergraduate Programs, at (301) 405-5310 for more information.

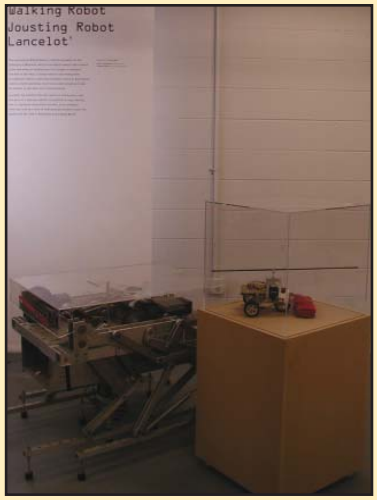
Left: The award winning solar-powered car 'Pride of Maryland', which blends bicycle and airplane technologies to create a lightweight, aerodynamic, non-polluting vehicle.

Below: A human-powered vehicle created for a 1999 ASME competition.

Above: A model of the solar house created in the summer of 2002 for the U.S. Department of Energy Solar Decathalon competition held on the National Mall in Washington, D.C.

Left: The 'Terpedo', created by students for the International Submarine Race competition in 2001 and 2003.

Right: A walking robot and jousting robot, created in the 80's in the Autonomous Mobile Robotics Laboratory at the University of Maryland to compete in international competitions.



Mechanical Engineering Photo Album

More scenes from the past year in the Department of Mechanical Engineering

Above: Undergraduate Director Sami Ainane, Chair Avram Bar-Cohen, and Jessica Galie, Academic Achievement Award winner for the Spring 2004 term.

Above: Professor Pat McCluskey and his students at the ME Alumni event held Tuesday, November 18.

Above: Dr. Avram Bar-Cohen meeting with the Administrators of Hanyang University of Korea in April.

Above: Dr. Avram Bar-Cohen, Professor Oh and C.D. Mote, Jr. after meeting to discuss collaboration between the University of Maryland and Hangyang University, Korea.

Above: Mechanical Engineering students from the ENME 489W (Waste Destruction Technology) class visited with Professor Ashwani Gupta to the Wheelabrator Baltimore Company that converts domestic Wastes to Energy.

Metrics is published twice a year for alumni and friends of the Department of Mechanical Engineering at the A. James Clark School of Engineering.

Your alumni news and comments are welcome. Please send them to: Editor, Department of Mechanical Engineering, 2181M Glenn L. Martin Hall, College Park, MD, 20742-3035.

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Visit our Web site at:
www.enme.umd.edu

Department Chair:
Dr. Avram Bar-Cohen
Editor:
Jim Barrett

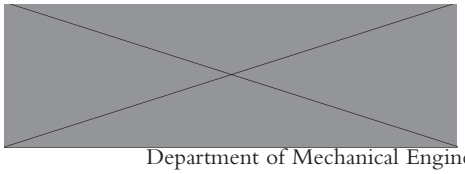
Mark Your Calendar

Summer I Term Begins
June 1, 2004

FutureTruck 2004 Competition
June, 2004, TBA
Michigan Ford Proving Grounds

West Coast Mechanical Engineering Alumni Event
November 13-19, 2004
Anaheim, California

International Sorption Heat Pump Conference
June 22-24, 2005
Omni Interlocken Resort, Broomfield, Colorado



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